Investigating Silicon Nutrition to Decrease Pythium Root Rot Severity in Snapdragons and New Guinea Impatiens

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Abstract

Control of Pythium root rot in greenhouse production typically involves preventive fungicide applications that are costly, may run off to the environment, and are sometimes ineffective due to pesticide resistance. Adding silicon (Si) to the fertilizer regime has improved the *Pythium* response of several greenhouse vegetable crops. Anecdotal evidence suggests that Si may also improve the *Pythium* response of floriculture crops, but no research trials have been conducted. In this project we seek to determine if silicon applied in the fertilizer program can provide a pesticide free approach to reduce *Pythium* infection of snapdragons and New Guinea Impatiens.

Background and Justification

Silicon (Si) is not considered an essential plant nutrient, however, several plant species demonstrate improved disease resistance when silicon is supplied in the nutritional regimen. Si is readily available in most soils but soilless substrates and fertilizers used in commercial greenhouse production contain little available Si. For floriculture crops Si has been reported to reduce incidence of powdery mildew and black spot in roses, and to reduce Botrytis blight in sunflower.

In greenhouse floriculture production, several species of *Pythium* can infect roots causing decay of the root system and ultimately leading to stunted plants or plant death. Economic damage is incurred due to loss of saleable plant material and/or due to labor and product costs of applying fungicide drenches to control *Pythium*. Further, resistance to specific fungicide products (Subdue and Subdue MAXX) has occurred in 40% of *Pythium* isolates (Garzon and Moorman). Silicon is reported to reduce *Pythium* infection of cucumber (Cherif et al., 1994), lettuce (Utkhede et al., 2000), and bitter gourd (Heine et al., 2007). Anecdotally, silicon reduced *Pythium* infection in experiments with well-watered poinsettias and in snapdragons (Mattson and Roland Leatherwood, personal observations). However, these experiments were not conducted to evaluate disease resistance so there were not specific inoculated treatments and non-inoculated controls. Currently there are no research-based studies reporting on potential silicon benefits for control of Pythium root rot in floriculture species.

In this project we will address IPM needs by evaluating whether silicon applications are a useful strategy to delay or reduce *Pythium* infection using a pesticide-free alternative.

Objectives

1. Conduct a greenhouse experiment to determine if silicon applied continuously in the fertilizer program or as a substrate-incorporated powder can reduce *Pythium* infection in two floriculture species
2. Evaluate the project to determine Si effectiveness and prepare final report
3. Distribute positive benefits (if found) via online newsletters and at greenhouse workshops

Procedures

A greenhouse experiment will be conducted on snapdragons and New Guinea impatiens, two floriculture species sensitive to infection from *Pythium irregulare*. Plugs or rooted liners of a susceptible cultivar from each species will be obtained from a commercial supplier and transplanted into 4-inch pots with a commercial peat-based substrate. All plants will receive continuous liquid feed supplied in the irrigation water at the rate of 200 ppm N from a commercial all-purpose fertilizer. Plants will be divided into three groups and receive the following silicon treatments: 1) no added Si; 2) 50 ppm Si from potassium silicate added to the irrigation water; or 3) 200 g m^3 Si from a hydratable potassium silicate powder incorporated into the potting mix prior to transplant.

Pythium irregulare isolates pathogenic to snapdragon and New Guinea impatiens will be cultured by M. Daughtrey. Two days after the snapdragon and New Guinea impatiens are transplanted, agar plugs of *Pythium irregulare* from 2-wk old potato dextrose agar cultures will be inserted into the containers near the plant root-zone. One-half of the plants will be inoculated; the other half will serve as uninoculated controls. The experiment will be arranged as a completely randomized block design (CRD) with 3 levels of Si supply and two levels of inoculation equaling 6 treatments. For each cultivar, 90 plants will be used allowing for 5 replicates per treatment with 3 plants per experimental unit. Following *Pythium* introduction, plants will be monitored weekly to record the progression of disease symptoms (plant wilting, stunting, or mortality). Controlled drought stress may be used to induce visible symptoms of *Pythium* infection. At experiment termination, a destructive harvest will be used to rank root symptoms on a 1-5 scale and plant dry weights will be determined.

Experimental results will be evaluated to determine if significant Si benefits in terms of reduced crop loss or delayed response to *Pythium* were found. The cost of Si applications and estimates of probability of *Pythium* infection in commercial crops will be used to evaluate whether preventative Si applications are an economically viable alternative to fungicide applications for these crops. If benefits are found, results will be disseminated via online newsletters and at regional greenhouse workshops that are already being offered in New York State.

Results to date:

Progress has been made in the following areas 1) greenhouse grower, Deborah Sweeton, was contacted to identify *Pythium* susceptible cultivars of New Guinea impatiens; 2) a *Pythium* *irregulare* strain is being cultured by Margery Daughtrey to inoculate containers once the experimental period begins; 3) the greenhouse experiment has been scheduled to begin April 1 at Cornell University, coinciding with the time of year when bedding plants are traditionally grown and when *Pythium* infection is often easily observed.